Claims

The following is a copy of Applicant's claims that identifies language being added with underlining ("___") and language being deleted with strikethrough ("~~———~~") or brackets ("**[[ ]]**"), as is applicable:

1. (Withdrawn) A fuel cell, comprising:

a membrane comprising a material selected from organic conducting materials, inorganic conducting materials, and combinations thereof, wherein the membrane has a thickness of about 0.01 to 10 μm, and wherein the membrane has an area resistivity of about 0.1 to 1000 ohms cm^2.

2. (Withdrawn) The fuel cell of claim 1, wherein the membrane has a thickness of about 0.1 to 5 μm.

3. (Withdrawn) The fuel cell of claim 1, wherein the membrane has a thickness of about 0.1 to 2 μm.

4. (Withdrawn) The fuel cell of claim 1, wherein the membrane has an area resistivity of about 1 to 100 ohms cm^2.

5. (Withdrawn) The fuel cell of claim 1, wherein the membrane has an area resistivity of about 1 to 10 ohms cm^2.

6. (Withdrawn) The fuel cell of claim 1, wherein the material is selected from silicon dioxide, doped silicon dioxide, silicon nitride, doped silicon nitride, silicon oxynitride, doped silicon oxynitride, metal oxides, doped metal oxides, metal nitrides, doped metal nitrides, metal oxynitrides, doped metal oxynitrides, and combinations thereof.

7. (Withdrawn) The fuel cell of claim 6, wherein the doped silicon dioxide is selected from phosphorous doped silicon dioxide, boron doped silicon dioxide, and combinations thereof.

8. (Withdrawn) The fuel cell of claim 1, further comprising a catalyst disposed on a first side of the membrane, wherein the catalyst is selected from platinum, platinum/ruthenium, nickel, tellurium, titanium, alloys of each, and combinations thereof.

9. (Withdrawn) The fuel cell of claim 8, further comprising a polymer layer on a second side of the membrane, wherein the polymer layer has a catalyst disposed on the side opposite the membrane.

10. (Withdrawn) The fuel cell of claim 1, wherein the membrane has a thickness of about 0.1 to 2 μm and wherein the membrane has an area resistivity of about 1 to 10 ohms cm^2.

11. (Currently amended) A micro-fuel cell, comprising:

a substrate having a top surface;

anode current collectors disposed ~~thereon~~ on the top surface of the substrate;

a membrane ~~disposed on~~ provided above the top surface of the substrate and contacting the anode current collectors~~, wherein the membrane comprises a material selected from silicon dioxide, doped silicon dioxide, silicon nitride, doped silicon nitride, silicon oxynitride, doped silicon oxynitride, metal oxides, doped metal oxides, metal nitrides, doped metal nitrides, metal oxynitrides, doped metal oxynitrides, and combinations thereof,~~

~~wherein the membrane has a thickness of about 0.01 to 10 μm, and wherein the membrane has an area resistivity of about 0.1 to 1000 ohms cm^2~~;

[[a]] hollow channels that are positioned above the top surface of the substrate and that pass through the membrane, ~~substantially~~ each channel being defined by ~~a portion of~~ the top surface of the substrate and ~~a portion of~~ inner surfaces of the membrane~~, wherein at least one catalyst layer is exposed to the channel, wherein the anode current collector is disposed adjacent the channel~~;

a first porous catalyst layer disposed on the inner surfaces of the membrane; and

a cathode current collector ~~disposed on~~ provided above the membrane ~~on the side opposite the substrate;~~

~~wherein there is an electrically conductive path between the catalyst layer and the anode current collector~~.

12. (Canceled)

13. (Currently amended) The micro-fuel cell of claim ~~12~~ 11, ~~wherein the~~ further comprising additional catalyst layers ~~is~~ disposed on the top surface of the substrate ~~exposed~~ within the channels, wherein there is an electrically conductive path between the additional catalyst layers, the first porous catalyst layer, and the anode current collector.

14. (Canceled)

15. (Currently amended) The micro-fuel cell of claim 11, further comprising a second porous catalyst layer disposed on top of the membrane ~~on the side opposite the substrate~~, wherein there is an electrically conductive path between the cathode current collector and the second porous catalyst layer.

16. (Currently amended) The micro-fuel cell of claim ~~15~~ 11, further ~~comprising a polymer layer disposed on~~ top of the side of the membrane ~~opposite the substrate,~~ and a second porous catalyst layer disposed on top of the polymer layer, wherein the cathode current collector ~~and the second porous catalyst layer are~~ is disposed on top of the ~~polymer layer~~ second porous catalyst layer.

17. (Original) The micro-fuel cell of claim 16, wherein the polymer layer is selected from perfluorosulfonic acid/polytetrafluoroethylene copolymer, polyphenylene sulfonic acid, modified polyimide, and combinations thereof.

18. (Currently amended) The micro-fuel cell of claim 11, wherein the first catalyst layer includes catalysts selected from platinum, platinum/ruthenium, nickel, tellurium, titanium, alloys thereof, and combinations thereof.

19. (Currently amended) The micro-fuel cell of claim 11, ~~wherein the~~ wherein the membrane has a thickness of about 0.1 to 5 μm and wherein the membrane has an area resistivity of about 1 to 100 ohms cm^2.

20. (Currently amended) A method for fabricating a micro-fuel cell, comprising:

providing a substrate having a top surface;

disposing ~~an~~ anode current collectors ~~disposed thereon~~ on the top surface of the substrate;

disposing a sacrificial polymer ~~layer onto~~ material on the top surface of the substrate and the anode current collectors;

removing the portions of the sacrificial material ~~not~~ disposed on the anode current collectors to form sacrificial polymer material portions that remain on the top surface of the substrate;

disposing a first porous catalyst layer ~~onto~~ on top of the sacrificial polymer material portions;

disposing a layer of a membrane material ~~onto the sacrificial material portions,~~ on top of the first porous catalyst layer**[[,]]** and the anode current collectors to form a membrane, ~~wherein the membrane material is selected from silicon dioxide, doped silicon dioxide, silicon nitride, doped silicon nitride, silicon oxynitride, doped silicon oxynitride, metal oxides, doped metal oxides, metal nitrides, doped metal nitrides, metal oxynitrides, doped metal oxynitrides, and combinations thereof~~; and

removing the sacrificial polymer material portions to form hollow channels that are positioned above the top surface of the substrate and that pass through the membrane, the channels ~~substantially~~ being defined by the top surface of the substrate**[[,]]** and the membrane ~~material, and the first porous catalyst layer~~.

21. (Currently amended) The method of claim 20, further comprising:

disposing a second porous catalyst layer ~~onto a top portion of~~ on the membrane ~~material on the opposite side of the membrane material as the substrate~~; and

disposing a cathode current collector ~~onto portions of~~ on the second porous catalyst layer.

22. (Currently amended) The method of claim 20, further comprising:

disposing a polymer layer ~~onto~~ on the membrane ~~material~~;

disposing a second porous catalyst layer ~~onto a top portion of~~ on the polymer layer ~~on the opposite side of the polymer layer as the membrane layer~~; and

disposing a cathode current collector ~~onto portions of~~ on the second porous catalyst layer.

23. (Original) The method of claim 20, wherein the polymer layer is selected from perfluorosulfonic acid/polytetrafluoroethylene copolymer, polyphenylene sulfonic acid, modified polyimide, and combinations thereof.

24. (Currently amended) The method of claim 20, further comprising:

providing **[[a]]** additional catalyst layers on ~~portions of~~ the top surface of substrate before disposing a sacrificial polymer layer, wherein the additional catalyst layers ~~is~~ are disposed ~~on portions of the substrate~~ between the sacrificial polymer material portions and the top surface of the substrate.

25. (Currently amended) The method of claim 20, wherein the sacrificial polymer material is selected from polyimides, polynorbornenes, epoxides, polyarylenes ethers, polyarylenes, inorganic glasses, and combinations thereof.

26. (Currently amended) A method for fabricating a micro-fuel cell, comprising:

providing a substrate having a top surface;

disposing ~~an~~ alternating anode current collectors ~~disposed thereon~~ and **[[a]]** catalyst layers ~~disposed thereon~~ on the top surface of the substrate~~, wherein the anode current collectors and the catalyst layer are adjacent one another~~;

disposing a sacrificial polymer ~~layer~~ material ~~onto~~ on top of ~~the substrate,~~ the anode current collectors**[[,]]** and the catalyst layers;

removing portions of the sacrificial polymer material ~~not~~ disposed on the anode current collectors to form sacrificial polymer material portions disposed on the catalyst layers;

disposing a layer of a membrane material onto the sacrificial polymer material ~~portions and the anode current collectors~~ to form a membrane~~, wherein the membrane material is selected from silicon dioxide, doped silicon dioxide, silicon nitride, doped silicon nitride, silicon oxynitride, doped silicon oxynitride, metal oxides, doped metal oxides, metal nitrides, doped metal nitrides, metal oxynitrides, doped metal oxynitrides, and combinations thereof~~; and

removing the sacrificial material portions to form hollow channels that are positioned above the top surface of the substrate and that pass through the membrane,

the channels being ~~substantially~~ defined by the top surface of the substrate**[[,]]** and the membrane ~~material, and the catalyst layer~~.

27. (Currently amended) The method of claim 26, further comprising:

disposing a ~~first~~ porous catalyst layer ~~onto~~ on the sacrificial polymer material portions prior to disposing the membrane material.

28. (Currently amended) The method of claim 26, further comprising:

disposing a ~~second~~ porous catalyst layer ~~onto a top portion of~~ on the membrane ~~material on the opposite side of the membrane material as the substrate~~; and

disposing a cathode current collector ~~onto portions of~~ on the ~~second~~ porous catalyst layer.

29. (Currently amended) The method of claim 26, further comprising:

disposing a polymer layer ~~onto~~ on the membrane ~~material~~;

disposing a ~~second~~ porous catalyst layer ~~onto a top portion of~~ on the polymer layer ~~on the opposite side of the polymer layer as the membrane layer~~; and

disposing a cathode current collector ~~onto portions of~~ on the ~~second~~ porous catalyst layer.

30. (Currently amended) The method of claim ~~26~~ 29, wherein the polymer layer is selected from perfluorosulfonic acid/polytetrafluoroethylene copolymer, polyphenylene sulfonic acid, modified polyimide, and combinations thereof.